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Nuclear Power Plant
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New York Power Authority

William A. Josiger
Resident Manager

May 30, 1989
IP3-89-042

License No. DPR-64
Docket No. 50-286

Mr. Charles E. Rossi, Director
Division of Operational Events Assessment
Office of Nuclear Reactor Regulation
Attn: Document Control Desk
Mail Station P1-137
Washington, D.C. 20555

Subject: Indian Point 3 Nuclear Power Plant
NRC Bulletin No. 88-11: "Pressurizer Surge Line Thermal Stratification."

Reference 1: Letter to Mr. Charles E. Rossi from Mr. William A. Josiger, dated March 21, 1989, entitled: "NRC Bulletin No. 88-11: Pressurizer Surge Line Thermal Stratification."

2: Letter from Mr. Joseph D. Neighbors to Mr. John C. Brons, dated May 17, 1989, entitled: "Schedular Relief Request Related to NRC Bulletin 88-11 Pressurizer Surge Line Thermal Stratification, Item 1.b."

Dear Sir:

In Reference (1), the Authority requested a schedule extension for item 1.b of NRC Bulletin 88-11. Reference (2) denied the schedular relief requested and required by the end of May 1989 that Indian Point 3 have available for NRC audit a bounding analysis meeting the requirements of item 1.b of the Bulletin. Reference (2) also stated that in the event the results of the bounding analysis do not confirm the adequacy of the pressurizer surge line, a Justification for Continued Operation (JCO) must be submitted.

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The Westinghouse Owners Group (WOG) has developed a preliminary bounding analysis. That bounding analysis has been used by the Authority to develop a Justification for Continued Operations (JCO) included as Attachment I to this letter. A final generic bounding analysis will be received from the WOG on June 15,1989. Upon its receipt the Authority will apply IP-3 specific variables to the analysis to demonstrate adequacy of the pressurizer surge line for the two years necessary to complete the detailed analysis (action 1d of the Bulletin). Analysis by the Authority using the preliminary information from the WOG indicates that surge line fatigue life is primarily dependent on the number of heatup and cooldown cycles. The WOG has indicated to the Authority that using worst case scenarios, no more than 50% of the fatigue life has been used at any Westinghouse plant and that for the design life of a plant, 200 heatup/cooldown cycles is considered normal. Therefore, approximately 100 cycles remain for the WOG worst case plant.

IP-3 has experienced 30 heatup/cooldown cycles which is well below the 100 cycles the WOG has assumed as a worst case and justifies the inclusion of IP-3 in the generic analysis.

Should you or your staff have any questions regarding this matter, please contact Mr. M. Peckham of my staff.

Very truly yours,

William A. Josiger
Resident Manager
Indian Point Unit 3
Nuclear Power Plant

SUBSCRIBED AND SWORN TO
BEFORE ME THIS 30th DAY
OF May, 1989.

Lorrie A. Hafner

LORRIE A. HAFNER
Notary Public, State of New York
No. 4828710, Dutchess County
Term Expires May 2, 1990

cc: Mr. William T. Russell
Regional Administrator, Region 1
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ATTACHMENT I TO IP3-89-042
JUSTIFICATION FOR CONTINUED OPERATION

New York Power Authority
Indian Point 3 Nuclear Power Plant
Docket No. 50-286
DPR-64

JUSTIFICATION FOR CONTINUED OPERATION
REGARDING
PRESSURIZED SURGE LINE STRATIFICATION

Indian Point 3

BACKGROUND

It was first reported in INPO SER 25-87 that temperature measurements at a German PWR indicated thermal transients different than design. Recent measurements at several domestic PWRs have indicated that the temperature difference between the pressurizer and the hot leg results in stratified flow in the surge line, with the top of the flow stream being hot (pressurizer temperature) and the bottom being colder (hot leg temperature). The top-to-bottom temperature difference can reach 250°F to 300°F in certain modes of operation, particularly during heatup and cooldown.

Surge line stratification causes two effects:

- Global bending of the pipe is different from that predicted in the original design.
- Fatigue life of the piping could be reduced due to the global and local stresses from stratification and striping.

More recently, the NRC has issued Bulletin 88-11 "Pressurized Surge Line Thermal Stratification," December 20, 1988, identifying actions to be taken by licensees.

a) Conduct visual inspection - walkdown
b) Update stress and fatigue analysis to account for stratification and striping
c) Obtain monitoring data, as necessary.

The bulletin encourages licensees to perform actions b) and c) above through collective efforts with other plants. In October 1988, the Authority and other members of the Westinghouse Owners Group (WOG) authorized a program to perform a generic evaluation of surge line stratification in Westinghouse PWRs that will address portions of Bulletin 88-11.

The WOG program is designed to benefit from the experience gained in the performance of several plant specific analyses on Westinghouse PWR surge lines. These detailed analyses included definition of revised thermal transients (including stratification) and evaluations of pipe stress, fatigue usage factor, thermal striping, fatigue crack growth, leak before-break, and support loads. The overall analytical approach used in all of these analyses has been consistent and has been reviewed in detail, by NRC staff.

As of March 1989, plant specific analyses have been performed on five domestic Westinghouse PWRs. In addition, twelve Westinghouse plants have completed or are currently performing an interim evaluation of surge line stratification which includes finite element structural analysis of their specific configuration under stratified loading conditions.

WOG PROGRAM STATUS

As part of the current WOG program, surge line physical and operating data have been collected and summarized for all domestic Westinghouse PWRs (55 units). Information relating to piping layout, supports and restraints, components, size, material, operating history, etc., has been obtained. This data has been evaluated in conjunction with available monitoring data and plant specific analyses performed by Westinghouse. The results of this evaluation were presented to the NRC during a meeting on April 11, 1989. The evaluation is being formalized into a Westinghouse topical report (WCAP 12277, Proprietary and WCAP 12278, Non-proprietary version) schelduled for submittal to the NRC on June 15, 1989. The topical report forms the basis of the following justification for continued operation.

JUSTIFICATION FOR CONTINUED OPERATION

A. Stratification Severity

Thermal stratification ($\Delta T > 100^{o}F$) has been measured on all surge lines for which monitoring has been performed and which have been reviewed by the WOG to date (eight surge lines).

The amount of stratification measured and its variation with time (cycling) varies. This variation has been conservatively enveloped and applicability of these enveloping transients has been demonstrated for plant specific analyses.

Various surge line design parameters were tabulated for each plant. From this, four parameters judged to be relatively significant were identified.

a) Pipe inside diameter
b) Piping slope (average)
c) Entrance angle of hot leg nozzle
d) Presence of mid-line vertical riser

These parameters were used in a grouping evaluation which resulted in the definition of 10 monitoring groups corresponding to various combinations of these parameters at Westinghouse PWRs. Approximately 40% of the plants fall into one group for which a large amount of monitoring data has already been received and for which the enveloping thermal transients, discussed above, are applicable. Indian Point 3 falls into this large group. The remaining 60% of Westinghouse PWRs are divided among the other nine additional groups. Although monitoring data has not yet been received representative of all these groups, in general, the combination of significant parameters of these nine groups is expected to decrease the severity of stratification below that of the enveloping transients. This conclusion is also supported by a comparison of available monitoring data.

B. Structural Effects

Significant parameters which can influence the structural effects of stratification are:

a) Location and design of rigid supports and pipe whip restraints
b) Pipe layout geometry and size
c) Type and location of piping components

Although the material and fabrication techniques for Westinghouse surge lines are reasonably consistent and of high quality, the design parameters listed above vary among Westinghouse PWRs. This variation in design is primarily a result of plant specific routing requirements.

A preliminary evaluation, comparing the ranges of these parameters to those of plants for which plant-specific analysis and interim evaluations are available (approximately 20% of Westinghouse PWRs), has been performed. This comparison indicates a high degree of confidence that, from a

combined transient severity and structural effects standpoint, the worst configuration has most likely been evaluated. This conclusion is supported by plant-specific analyses covering five plants and interim evaluations of six additional plants (interim evaluation is in progress on six more plants as of March 1989). These analyses and evaluations have included various piping layouts, pipe sizes, support and restraint designs and piping components. Although the full range of variation in these parameters has not been evaluated, experience gained from these evaluations indicate that further evaluations will not result in a more limiting configuration than those already evaluated. The Indian Point 3 surge line is of a standard configuration and pipe size compared to the majority of other plant arrangements, with no unusual fittings or welded attachments. Therefore, Indian Point 3 should be enveloped by the configurations already evaluated.

C. **Operating Procedures**

The WOG currently has available the surveys of operating procedures performed in support of existing plant-specific analyses. Experience indicates that heatup and cooldown procedures have a significant effect on stratification in the surge line. All conclusions reached by the WOG to date have assumed a steam bubble mode heatup and cooldown procedure which may result in a temperature difference between the pressurizer and reactor coolant system (RCS) hot leg of more than 300°F. In many cases, individual plant operating procedures and technical specifications provide limits on this value. The Indian Point 3 operating procedures call for the formation of a steam bubble and limit this temperature difference to 320°F. It is also known that some procedures utilize nitrogen, during at least part of the heatup/cooldown cycle, as a means of providing a pressure absorbing space in the pressurizer. Based on information currently available to the WOG, a high confidence exists that the steam bubble mode heatup, assumed to date, is conservative with respect to Westinghouse PWRs.

D. **Pipe Stress and Remaining Life**

The design codes for surge line piping have requirements for checking pipe stress limits and the effects of fatigue loadings. These stress limits provide a means of controlling stress from primary loads such as pressure, deadweight, and design mechanical loading, as well as stress from secondary loads such as thermal and anchor motion effects.

Stratification in the surge line is a secondary load which will only affect the qualification of secondary stresses. The qualification of primary stresses is not affected by this loading.

Secondary stresses are controlled to prevent excessive displacements and gross plasticity and to prevent excessive fatigue loadings in the pipe. The basic characteristic of a secondary stress is that it is self limiting; thus, a failure from a single application of a secondary loading is not expected.

For the stratification issue, the potential effects of excessive displacements have been investigated through the detailed visual examination of the surge line during the walkdown required per Bulletin 88-11 action 1.a. As discussed in Reference (1), the results of the visual examinations were acceptable. No gross discernible distress or structural damage was evident. There were no loose parts, debris, abnormal corrosion products, wear, erosion or loss of integrity at bolted or welded connections.

The effects of secondary stresses on the remaining life of the surge line have been evaluated on a generic basis through the WOG program. The following summarizes the results of this evaluation.

All plant specific analyses performed as of March, 1989 have demonstrated compliance with applicable ASME Codes and a surge line fatigue life in excess of a 40 year plant life. Review of plant specific fatigue calculations indicates that the surge line fatigue life is primarily dependent on the number of heatup and cooldown cycles, rather than years of operation.

Considering the worst case years of operation (28.5 yr) in combination with the worst case number of heatup/cooldown cycles (75, at a different plant) at any Westinghouse PWR, and assuming a 40 year life for all surge lines, it is estimated that no more than approximately 50% of the fatigue life has been used at any Westinghouse plant to date.

For a design life considering 200 heatup/cooldown cycles (used in plant specific analyses), this would indicate approximately 100 remaining cycles. This number of remaining cycles far exceeds the postulated worst case number for the two-year time frame needed to resolve the stratification issue. As of May 1989 Indian Point 3 has experienced only 30 heatup/cooldown cycles.

E. **Leak Before Break**

All the plant specific analyses performed to date that have included the loadings due to stratification and striping have validated the "leak-before-break" concept and have substantiated a 40-year plant life. Fatigue crack growth calculations, performed as part of these plant specific analyses, have demonstrated that any undiscovered crack as large as 10% of the wall thickness would not grow to cause leakage within a 40-year plant life. Nevertheless, any postulated through wall crack propagation would most likely result in "leak-before-break" and thus permit a safe and orderly shutdown.

F. **Inspection History**

The NDE inspection history at Indian Point 3, has not revealed any service induced degradation in the surge line piping that has been attributed to thermal stratification.

SUMMARY OF CONCLUSIONS FROM WOG PROGRAM

Based on information assembled on surge lines for all domestic Westinghouse PWRs, and evaluation of that information in conjunction with plant-specific and other interim evaluation results, the WOG concludes that:

- A high degree of confidence exists that further evaluation will confirm that the worst combination has already been evaluated for stratification severity, structural effects and operating procedures.
- All plant specific analyses, to date, have demonstrated a 40-year life of the surge line. Assuming that further evaluation leads to the same conclusion for the remaining Westinghouse PWRs, the worst case remaining life is approximately 100 heatup/cooldown cycles.
- Through wall crack propagation is highly unlikely, however, "leak-before-break" would permit a safe and orderly shutdown if a through wall leak should develop.
- NDE inspection history demonstrates the present day integrity of Indian Point 3 pressurizer surge lines.
- While additional monitoring, analyses, and surveys of operating procedures are expected to further substantiate the above conclusions, the presently available information on surge line stratification indicates that Westinghouse PWRs may be safely operated while additional data is obtained.

OVERALL CONCLUSION

Based on the above discussions, the Authority believes it is acceptable for Indian Point 3 to continue power operation for at least ten additional heatup/cooldown cycles. The Authority is committed to addressing the requirements of Bulletin 88-11 by January, 1991.